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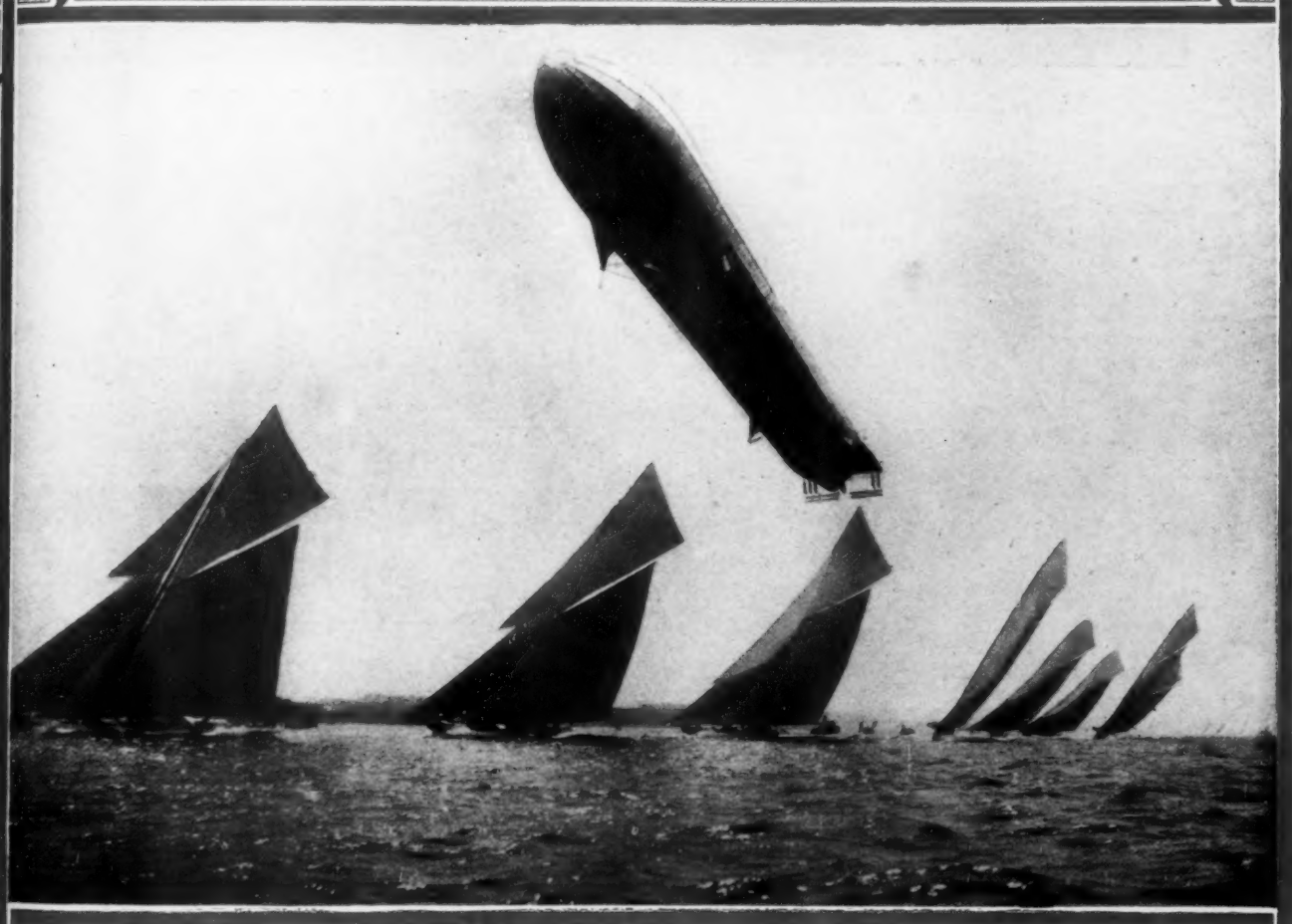

A Zeppelin Observing Yacht Races

JANUARY 15th 1917

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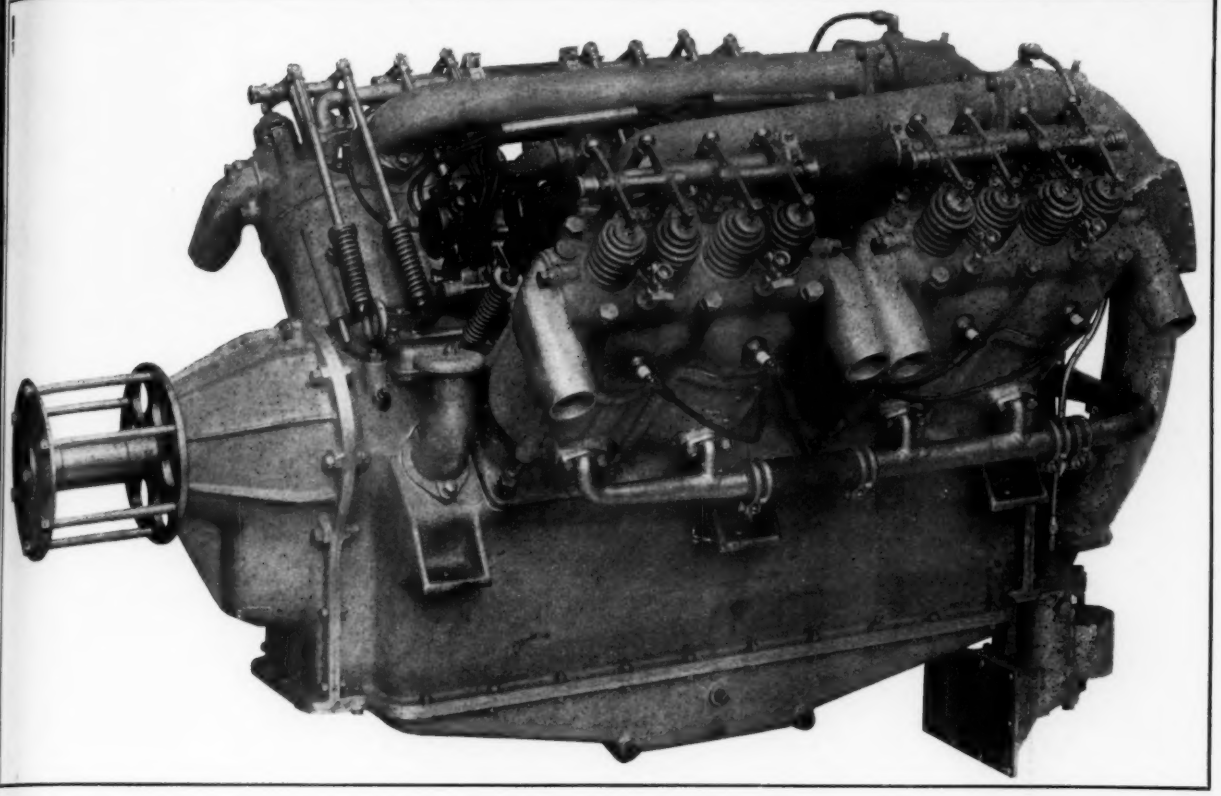

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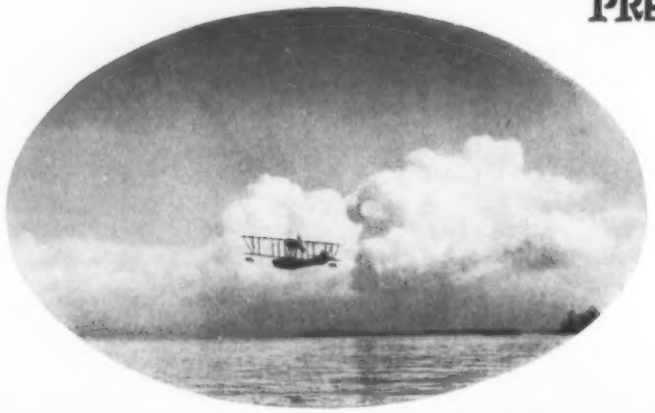

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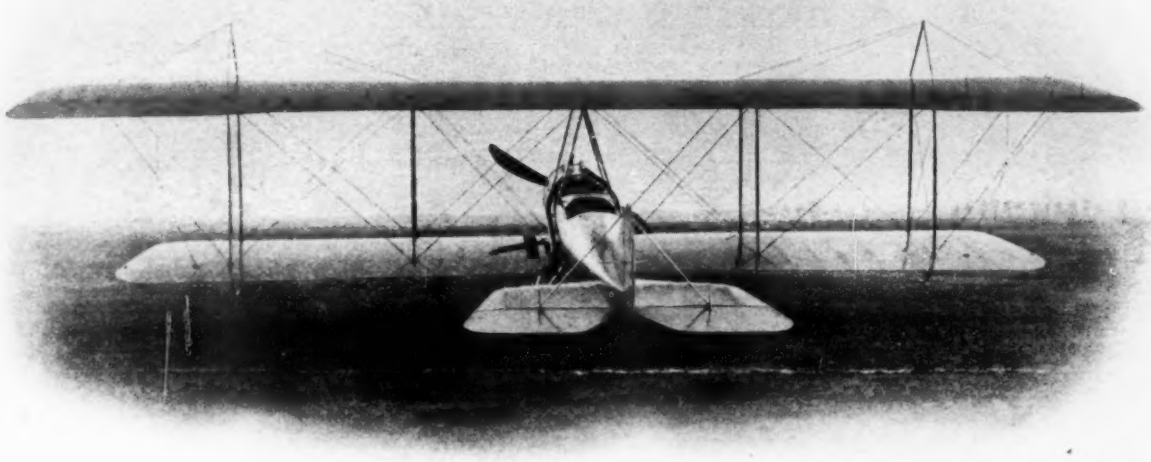

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JANUARY 15, 1917

AVIATION
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AERONAUTICAL ENGINEERING

VOL. I. NO. 12

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AVIATION AND AERONAUTICAL ENGINEERING

TECHNICAL EDITOR
A. KLEMIN, A.C.G.I., B.Sc., S.M.
Instructor in Aeronautics
Massachusetts Institute of Technology

MANAGING EDITOR
HERBERT M. WILLIAMS, B.S.

Vol. I | January 15, 1917 | No. 12

PERHAPS the most important sign of the co-ordination which is taking place in aeronautics in this country appeared when the Society of Automobile Engineers adopted the name "Automotive" at its annual meeting in New York. The precedent which this action established of combining the engineers of the automobile, tractor, marine and aeronautic fields will be followed in other organizations without doubt.

The National Automobile Chamber of Commerce has already taken the first step toward considering a similar move which would unite in one large body the commercial interests of all concerns whose product is based on the gas engine.

In a new industry such as is growing around the airplane, it is natural to expect a period of individualism which will change eventually to one of co-operation. At the present time when all the companies are practically selling to one customer and are influenced by the special requirements of the government, it should be easy to effect a co-operative union almost at once.

If at the same time the whole force of the automobile industry can be allied with the airplane industry, it will probably be of great advantage to both.

In this period of change, The Aero Club of America will also be affected. Hitherto, it has assumed the leadership in fields which no organization on club lines should enter. With the engineering interests centered in the new S. A. E. and the commercial problems looked after by a separate organization, the Aero Club can concentrate its attention on its two natural functions, the control of the sport of aviation and the encouragement of governmental interest.

To do this most successfully, a different policy than has been adopted in the past will be necessary and it is gratifying to learn that a committee has been appointed by the club to report on the work that the club should undertake together with any reorganization that may seem advisable.

Army and Navy to Build Zeppelin Together

The decision of the Navy and Army to unite in the construction of a dirigible of the Zeppelin type gives the country the assurance that there is at least a possibility of this important aircraft being built.

The estimated cost of constructing a Zeppelin is so large that it has been difficult for any private concern to undertake this work. The uncertainty as to the most useful size and the great risk involved in such experimental work have prevented progress without strong governmental encouragement. There have been some efforts made to design large airships but now that the government has taken up the matter, the possibility of private enterprise is slight until the first ship is built and demonstrated.

The danger of the present plan is that it will probably be a long time before actual work is begun and then owing to the necessity of satisfying the needs of many different officers delays will occur. There should be no time lost in this work. We should have aircraft of all types and sizes and it is to be hoped that all those in charge of the construction of this first Zeppelin will do everything possible to expedite its completion.

The Report on the Royal Flying Corps

The report of the Judicial Committee which investigated the British Royal Flying Corps is startling in its frankness and should by its recital of the difficulties encountered by the English authorities give courage to American constructors.

The report states at the outbreak of the war the R. F. C. had only 179 airplanes. Of these 66 were sent to France. Of the remainder only 20 were in serviceable condition so that the Corps started to try to secure command of the air with a mere handful of airplanes. It is also interesting to note that the R. F. C. had no engine of over 80 horsepower at the beginning of the war.

The number of pilots under training now is not given but the statement is made that the R. F. C. has multiplied more than twenty-fold since July 1914.

Other interesting facts disclosed were that all three of the Zeppelins brought down on September 2, September 23 and October 1 last year were brought down by B.E.2c machines fitted with Royal Aircraft Factory 90 horsepower engines; that there was no school for air fighting for over a year after the war began; that during the first year of the war, or until the German Fokkers appeared, there was practically no fighting in the air; that machines loaded with a variety of apparatus termed "Christmas Tree" machines were no longer approved; and finally that anti-aircraft guns have made hits at 20,000 feet.

All these facts are encouraging in the light of the position occupied by the R. F. C. to-day. The American air service is but little behind the position occupied by the Royal British Flying Corps, in August 1914. There are now under order about 500 airplanes for the army and re-orders are awaiting the delivery of these machines. With British experiences to guide us we should be able to avoid such errors as the Royal Flying Corps experienced.

Notes on Speed Indicators for Airplanes

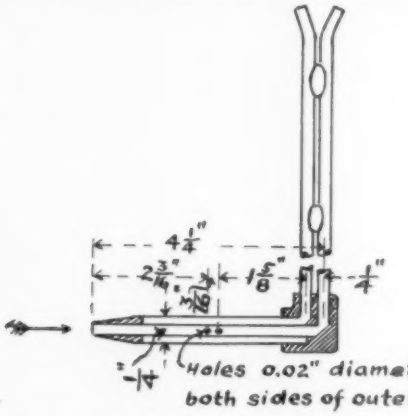
The Pitot Tube

By Winslow H. Herschel

of the Bureau of Standards

There are two dangers which an aviator must guard against by the use of a speed indicator. Too low a speed may lead to stalling; that is, the speed is so low that the weight of the airplane is not sustained, and on the other hand too high a speed may cause excessive stress and possible breakage. The speed indicator must be independent of the engine, because it is in gliding, with the engine still, that excessive speed is most likely to occur. On this account no form of engine tachometer can fulfill the purpose of the air speed meter.

Speed indicators, in general, consist of two parts, the head which receives the impact of the relative wind, and the gage, which must be placed within view of the pilot. It is important that the head should be placed sufficiently far from the body so that it will not be influenced by eddy currents, and a position near a wing tip seems preferable. Even when so placed it must be remembered that the disturbance pro-



EXAMPLE OF A PITOT TUBE USED BY ROWSE, DESIGNED BY THE AMERICAN BLOWER COMPANY

duced by a body passing through the air extends some distance in front of it. On account of the considerable distance between the head and the gage, the connection between them should be easily changed in length without causing a change in the indications of the instrument, as otherwise, if the instrument were applied to another make of airplane, a new graduation of the gage might become necessary.

While, strictly speaking, all types of speed indicators with the exception of the rotary anemometer, have to be pointed directly into the wind in order to give correct readings, the angle between the relative wind and the direction of flight would be so small, in the case of a high speed airplane, as not seriously to invalidate the readings of the indicator. It is therefore possible to fix the head permanently in the direction of flight, which avoids the undesirable complication of mounting it on a wind vane. It would be desirable, however, to mount the instrument so that it could be tilted when the angle of incidence was changed, as otherwise a greater error might be introduced than would be caused by the absence of a wind vane.

As an airplane does not always remain in an upright position, any instrument should be constructed so as to be independent of the effect of gravity, and if so designed, it would also be independent of the effect of vertical acceleration.

In the great majority of cases, the determination of true velocity is of secondary importance, so that is is practically no objection to a speed indicator if correction has to be made for air density when the true velocity is desired. On the other hand, it is an important advantage if no correction has to be made to the readings in order to find the relative sustaining power.

The principal types of speed indicator, which are to be considered with respect to their fitness for airplane conditions, are the rotary anemometer, pressure plate, Pitot tube and Venturi tube. Speed indicators of the true anemometer type, such as the Robinson anemometer used by the Weather Bureau, are affected little if at all by changes in air density.

A speed indicator adapted for airplanes is made by Wilhelm Morell, of Leipzig, by combining a Robinson anemometer with a tachometer of the centrifugal pendulum type. Such an instrument should be very serviceable if used primarily to determine velocity rather than safety in flight.

The pressure plate is objectionable on account of the large head resistance, and the necessity of having a rigid connection between the head and the gage. There is also considerable doubt as to the extent that the indications of such an instrument are affected by differences in air density. If pressure plates and rotary anemometers are omitted from further consideration, the Pitot tube and Venturi tube remain as the most important types. We shall deal with the Pitot tube now and reserve consideration of the Venturi tube to a later article.

THE PITOT TUBE

In the Pitot tube the head consists of a dynamic opening pointing directly into the current, and a static opening at right angles to it. If the two openings are connected to the two sides of a U-tube manometer containing a liquid of density, d, while the density of the air in which the Pitot tube is placed is ρ, the velocity of the air may be obtained from the formula

$$V = C\sqrt{\frac{2\,ghd}{\rho}} \qquad (1)$$

where h is the head shown on the manometer, g is the acceleration of gravity, 32.17 feet/seconds squared (9.81 meters/seconds squared), and C is a coefficient to be determined by experiment. In the case of a Pitot tube used on an airplane, V would be the velocity of flight.

It has been shown by Rowse * that with proper care in the design and use of the Pitot tube, C may, for all practical purposes, be taken equal to unity. To give correct readings, the static tube must be constructed with great care, though almost any form of dynamic opening will give good results. The dynamic tube must be pointed directly against the current, which is not possible when there is turbulence, and there must not be rapid variations in velocity, as the velocity calculated from the average head, indicated by the gage, is not the true average velocity.

It has been claimed by some experimenters that a different value of C was obtained according to whether the tube was calibrated by moving it through still air, or placing it in a current of moving air, but Fry and Tyndall † have shown that for velocities above 11 miles per hour (17.7 kilometers) both methods of standardization gave the same result. This shows that if the tube is of a form found by tests in moving air to have a coefficient of unity, then the coefficient C in Equation 1 may be taken to equal to unity when calibrating a speed meter by moving it through still air, by means of an automobile, or on the airplane itself.

If C is taken equal to unity, Equation 1 may be written

$$V = K\sqrt{\frac{h}{\rho}} \qquad (2)$$

and values of K taken from Table 1.

TABLE 1.

VALUES OF K FOR EQUATION 2.

h measured in:	ρ measured in:	V measured in:	K
Inches of water at 20° C. (68° F.)	$\frac{\text{Pounds}}{\text{Feet}^3}$	Feet per second	18.28
		Miles per hour	12.46
Millimeters of water at 20° C. (68° F.)	$\frac{\text{Kilograms}}{\text{Meters}^3}$	Meters per second	4.426
		Kilometers per hr.	15.93

To calculate the air density, ρ, the following quantities must be known or assumed:

B = the barometric pressure.

t = the temperature of the air.

P = pressure of saturated steam at t degrees, from the steam tables.

H = the relative humidity.

* W. C. Rowse, Transactions American Society of Mechanical Engineers, 1913, page 633.

† J. D. Fry and A. M. Tyndall, *Philosophical Magazine*, 1911, page 348.

Then, in English units, if B and P are in inches of mercury, and t in degrees F.,

$$\rho = 1.327 \frac{B - 0.376\,P\,H}{460 + t} \text{ pounds/feet}^3 \quad (3)$$

or in metric units, if B and P are in millimeters of mercury and t in degrees $C.$,

$$\rho = 0.464 \frac{B - 0.376\,P\,H}{273 + t} \text{ kilograms/meters}^3 \quad (4)$$

The calculations required by Equation 3 may be avoided by the use of diagrams given by Rowse and by Taylor.* Hinz † gives a diagram showing the gas constant of moist air which may be used in place of Equation 4.

The above equations and table give all the data necessary to calibrate a Pitot tube. If the gage is correctly graduated, and the apparatus is in good order, the head calculated from the observed velocity by means of Equation 2 should agree with the observed head, allowance being made for the difference between the air density during test and that assumed by the maker of the instrument.

In considering the error due to changes in air density, Darwin ‖ makes the usual assumption that there is a fall of 1 degree F. for every 300 feet (0.61 degrees C. per 100 meters), rise above the earth's surface. He gives Table 2 showing velocities indicated by a Pitot tube manometer, the actual speed being at all times 100 miles (161 kilometers) per hour.

TABLE 2.

PITOT TUBE READINGS FOR VARIOUS ALTITUDES, FOR V = 100 MILES PER HOUR.

Height.		Speed Readings Temperature Constant.		Speed Readings, Temperature Falling with Height.	
Feet.	Meters.	Miles.	Kilometers.	Miles.	Kilometers.
0000	0000	100.0	160.9	100.0	160.9
1000	305	98.3	158.0	98.6	158.7
2000	610	96.5	155.3	97.1	156.1
3000	914	94.7	152.3	95.7	154.0
4000	1219	93.0	149.8	94.3	151.8
5000	1524	91.3	147.0	92.9	149.7

While the errors shown by the table are considerable, it should be remembered that the safety against stalling is the same for a given manometer reading, whatever may be the density of the air and the consequent error in the readings as an indication of actual velocity.

Taking the weight of a cubic foot of air as 0.0715 pounds (1.145 kilograms/meters^3), Equation 2 gives a head of 1.15 inches (29.2 millimeters for a speed of 50 miles or 80 kilometers, per hour), which shows the desirability of magnifying the manometer reading. On account of the rocking of the airplane, this could not be done by using inclined columns of liquid such as are conveniently employed under other conditions. Some advantage may be derived from the use of a differential gage, and it is claimed for a manometer of this type, especially designed for airplanes, that the error is only 1.5 per cent when the manometer is 10 degrees out of the vertical.§

It is thus apparent that the problem with the Pitot tube is to make a satisfactory gage, without the use of liquids which shall be sufficiently sensitive to give the required open scale readings at velocities approaching the stalling speed, and must also be durable enough not to suffer from vibrations and shocks experienced in landing.

* D. W. Taylor, Society of Naval Architects and Marine Engineers, November, 1905, page 39 and plates 33 and 34.
† A. Hinz, Thermodynamische Grundlagen der Kolben and Turbokompressoren, page 42.
‖ H. Darwin, *Aeronautical Journal*, July, 1913.
§ *Deutsche Luftfahrer veitschrift*, August 6, 1913, page 386; *Aeronautical Journal*, July, 1913.

The Heat Treatment of Steel

By J. M. Rogers, M.E.

Research Metallurgist, The Curtiss Aeroplane and Motor Corporation

The heat treatment of steel is of great importance in airplane construction. Airplane fittings and engine parts should be made as light as possible without impairing their strength. The steel from which they are made should therefore have the greatest possible strength and sufficient resilience to resist the shocks to which fittings of engine parts are subjected. For steel to attain the above properties, it is necessary that it receive very careful heat treatment.

FIG. 1.

Steel forging, .25 carbon, magnified 50 diameters, showing a coarse and distorted pearlitic structure.

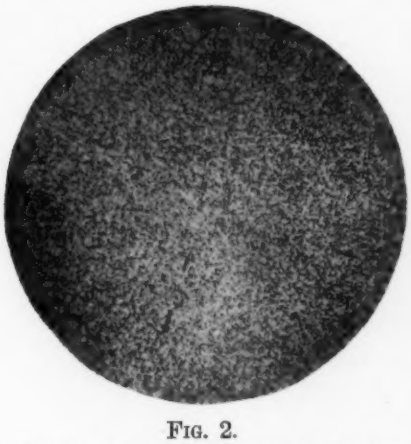


FIG. 2.

Steel forging, .25 carbon, magnified 50 diameters, showing fine sorbitic structure after heat treating.

FIG. 3.

Badly overheated steel, magnified 50 diameters, showing a very coarse pearlitic structure.

The three principal reasons for heat treating are to harden and toughen the steel, and refine its structure. There is always a great deal of uncertainty as to the physical condition of steel that has not been heat treated. Several portions of a bar or forging may have been finished at different temperatures, or one bar or forging may have been finished at a higher or lower temperature than another. These conditions would cause a variation in the physical properties of the steel which would not be at all desirable.

It will also be found that the structures of steel castings and drop forgings, which have been finished at high temperatures, are very coarse. All important steel castings and drop forgings should be heat treated for the purpose of refinement, as a coarse structure greatly impairs strength and ductility. It is evident from the above statements that it is necessary to heat treat steel when the best physical properties obtainable are desired.

There are five different structures found in steel: austenite, martensite, troostite, sorbite, and pearlite. When a piece of steel is heated to a temperature above the critical range, *i. e.*, temperature range over which the transformations of structure take place, the structure becomes austenitic and this transformation is accompanied by a refinement of grain. As the piece is slowly cooled through its critical range, there is a transformation from an austenitic to a pearlitic structure, the steel passing through the transitional structures in the order

given above. The physical properties of these structures for carbon steel are given in the following table:

Structure.	Strength in thousands of pounds per sq. in.	Ductility.	Hardness.	Resistance to shock.	Resistance to fatigue.
Austenite	150-200	30	1.5	very good	good
Martensite	?	0	4-5	very poor	very poor
Troostite	200	2-5	2	fair	very good
Sorbite	160	5-10	1.6	good	very good
Pearlite	140	10-15	1.5	good	poor
Ferrite (Pure α iron)	40	40	1	fair	fair

The completeness of this transformation depends upon the rate of cooling throughout the critical range. The transformation from austenite to martensite is very rapid, and austenite is never found in commercially heat treated steel except in the special case of austenitic alloy steels.

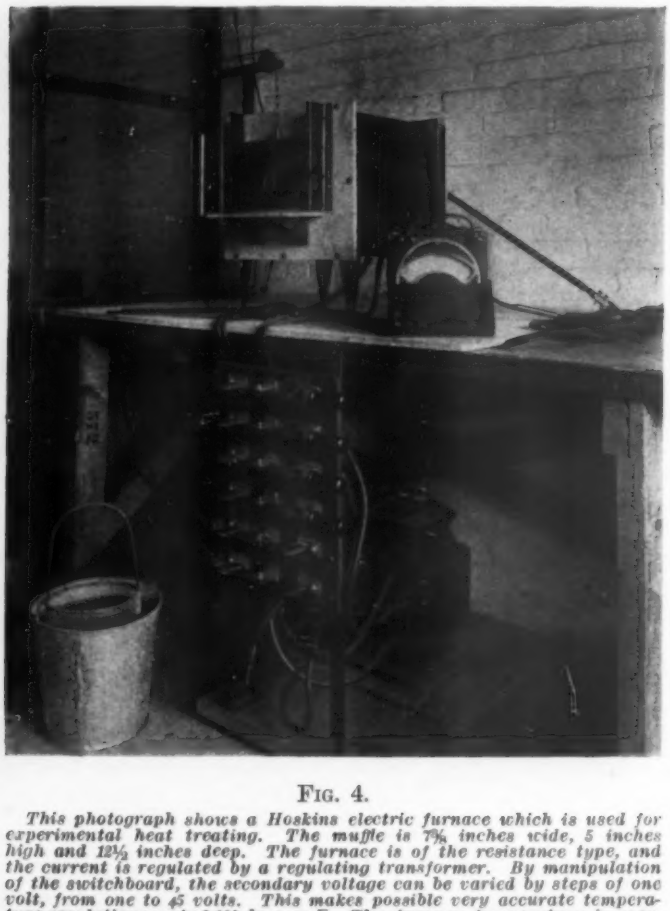


FIG. 4.

This photograph shows a Hoskins electric furnace which is used for experimental heat treating. The muffle is 7⅝ inches wide, 5 inches high and 12½ inches deep. The furnace is of the resistance type, and the current is regulated by a regulating transformer. By manipulation of the switchboard, the secondary voltage can be varied by steps of one volt, from one to 45 volts. This makes possible very accurate temperature regulations up to 2,000 degrees F. The furnace temperature is measured by a resistance-type pyrometer, the fire iron to which it is connected being inserted into the muffle at the back of the furnace. This furnace has been found to give very uniform heats.

A high carbon steel quenched from above the critical range, will contain a large percentage of martensite, but as the carbon content decreases the structure becomes troostitic or sorbitic. After quenching, there are internal stresses in the steel resulting from the rapid cooling, and it is necessary to draw, *i. e.*, reheat the piece to a temperature below the upper limit of the critical range, in order to remove them. The higher the drawing temperature, the greater is the tendency for the steel to become pearlitic, and by properly choosing the drawing temperature, any desired completeness of this transformation may be obtained.

The physical properties of steel may be greatly improved by the addition of certain elements. Nickel, chromium and vanadium are used to a great extent. The steels to which these elements have been added are known as alloy steels. Nickel increases the hardness, toughness and tensile strength, with only a slight decrease in ductility; chromium imparts great hardness; and vanadium gives a very good combination of strength and toughness. All of the above elements increase the elastic ratio. Alloy steels can be greatly improved by heat treating.

The determination of the proper quenching temperature is of great importance. The steel must be heated sufficiently above the critical range to refine the structure and give the maximum rate of cooling on quenching as the temperature passes through the critical range. The location of the critical range can be determined from a thermal curve, and usually can be obtained from the manufacturer of the steel.

The question as to how far above the critical range the quenching temperature should be, depends upon a number of considerations. There is a tendency for the crystals to grow when the steel is heated above its critical range, and the rapidity of this growth increases with the temperature. Therefore, it is not desirable to heat the steel any more above the critical range than necessary, or to hold it at that temperature any longer than necessary.

If the grain of a piece of steel is very coarse, it is necessary to heat it considerably above the critical range to refine the steel, but the resulting structure will not be as fine as it would have been had the structure been finer at the start. This difficulty may be overcome by heating the piece sufficiently to refine it, then cooling slowly or rapidly, and reheating slightly above the critical range, and finally quenching.

The size of the piece and the temperature drop between the furnace and quenching bath, are important considerations in determining the proper quenching temperature. In heating a piece of steel to its quenching temperature, the furnace temperature should be brought up slowly enough to give a uniform heat, and the piece should be permitted to soak at the quenching temperature for a few minutes only. The temperature of the quenching medium should not be permitted to vary sufficiently to appreciably affect its quenching speed. There are quenching oils which will give uniform quenching speeds over large temperature variations.

Steel is drawn after quenching in order to remove any strains resulting from the rapid cooling, and to toughen it, if it has been made too brittle. The time of drawing depends upon the size of the piece, a longer time being required for larger pieces. A salt bath is very satisfactory for drawing at low temperatures.

The successful heat treating of steel depends a great deal upon the furnace man and the equipment with which he has to work. He must be able to regulate his furnaces accurately; use his judgment as to whether the steel is up to furnace temperature; and look after a number of small details, such as the arrangement of the steel in the furnace, the method of quenching, the location of the pyrometer fire iron in the furnace, etc.

The furnaces should be so constructed as to give uniform heats and absolute temperature regulation. An accurate pyrometer is absolutely essential. The potentiometer and high resistance types of pyrometers are most accurate, and it is quite important that they be compensating for cold end corrections.

It is quite important that there be a constant check kept upon the heat treated products, by making physical tests and microscopic examinations of the structure. In this way, any irregularities in physical properties and structure are immediately detected. To obtain a uniform heat treated product, it is very important that there should be no appreciable variations in the chemical composition of the steel and frequent chemical analyses should be made to detect any such variations.

Aeronautical Patents

Copies of these patents may be obtained for five cents each by addressing the "Commissioner of Patents, Washington, D. C."

ISSUED DECEMBER 26, 1916.

1,210,373. Filed September 18, 1915. To Glenn H. Curtiss, Buffalo, N. Y. Exhaust heater for air-inlets

1,210,374. Filed October 18, 1915. To Glenn H. Curtiss, Buffalo, N. Y. Hull for flying boats.

1,210,376. Filed June 15, 1915. To William Morton James, Manchester, England, assignor of one-half to Ridley J. Urquhart, Liscard, near Birkenhead, England. An airplane.

1,210,379. Filed January 28, 1915. To Henry Kleckler, Hammondsport, N. Y. Aileron system.

1,209,923. Filed October 21, 1915. To Charles Arthur Wragg, Melbourne, Victoria, Australia. An airplane.

ISSUED JANUARY 2, 1917.

1,210,418. Filed April 24, 1916. To Denis F. Cashman, Dayton, O. Control for aerial vehicles.

1,211,131. Filed April 14, 1915. To George A. Furneaux, Dufur, Ore. An airplane.

ISSUED JANUARY 9, 1917.

1,211,896. Filed October 31, 1914. To Charles J. Thomas, Brooklyn, N. Y. A kite trolley.

Requirements of Airplane Floats

By Naval Constructor H. C. Richardson

Among the pioneer airplane builders the advantages to be gained by starting from the surface of the water were appreciated, and numerous efforts are recorded along these lines, though no success was really attained until Curtiss' flight at San Diego in February, 1911. Looking back, it is clear that sufficient reserve power and proper lines for the floats were principally responsible for the failure of earlier efforts.

Early in 1911 the Navy Department inaugurated a systematic investigation at the Model Basin with models and with full size construction. In this manner all known forms of float construction, comprising simple floats, stream-line floats, single and multiple steps, flat bottom, V-bottom, hollow V-bottom, ventilated, and non-ventilated steps, convex bows, straight bows, concave bows, corrugated bows, ship-shape bows, submerged lifting vanes, mud-guards, etc., have been investigated by means of models. Sufficient comparative data has been obtained to warrant the assertion that model experiments are a valuable guide in the development of new types, in the comparison of different types and in the prediction of performance of full size floats. Froude's Law of Comparison appears entirely satisfactory for this work.

From the beginning it has been apparent that the development of floats was equally important to the development of motors as an essential to the success of naval aeronautics. Every bit of information available and every effort has been used toward the determination of the float problem and its solution. In order to arrive at an understanding of the difficult nature of the float problem the principal float requirements are here stated in general terms:

SEAWORTHINESS

Seaworthiness in a broad sense starts with adaptability, storage and handling, for the airplanes must be stored and handled aboard ship or ashore, and a still further naval requirement is that of adaptability to launching by mechanical means from aboard ship.

When *adrift*, the floats must provide the necessary buoyancy to carry the full load with sufficient reserve to provide against loss of buoyancy due to a damaged compartment, and at the same time to provide sufficient righting moments to prevent capsizing in a strong wind on a rough sea. Preferably when drifting, the airplane should head into the wind. This is more readily specified than secured though the use of a sea anchor should readily insure this and other advantages.

Underway at less than flying speeds the airplane should be capable of maneuvering readily and freely in all directions without danger of capsizing. Abnormal squatting is to be avoided. Planing should begin at a moderate speed and gradually and without involving use of excessive power. When planing is attained, it should be possible freely to change the attitude of the airplane longitudinally in order to facilitate or retard the get away, and to prevent interference because of the conformation of the wave surface. The latter requirement is of little consequence in the open sea.

The planing power requires a compromise for the reason that when headed into a wind the speed required over the water becomes less, due to the relatively higher wind speeds corresponding to surface speeds, and the consequent greater assistance to planing given by the lift of the wings. Exactly the converse holds true when running down wind, so that in the latter case a float which planes properly in a calm planes too early down wind, which is a quality to be avoided.

Wide floats plane readily, but in some cases too readily, as it is highly undesirable to take the air before flying speed is attained, which results in the airplane taking the air before the controls are fully effective, and also because it involves the possibility of the airplane being tossed off rough water and falling back to the surface, with only a part of the load carried by the wings, which means that the floats have to stand severe punishment. It is largely for this reason that it is very desirable to be able to vary the attitude of the airplane as soon as planing is attained.

When planing across wind it is very desirable that there should be no danger of capsizing on account of the leeway made over the surface.

AIRWORTHINESS

The additional weight of the floats seriously affects the performance of the airplane as well as its airworthiness, due to the lowering of the center of gravity. This effect is augmented by the weight of the substructure, which has to be rugged to withstand the heavy shocks imposed when landing and getting away on rough water.

The additional resistance of the floats seriously affects the performance of the airplanes, as well as its airworthiness, due to the location of the floats and their individual aerodynamical qualities, and also due to their effects on the flow of air to the supporting and tail control. The form of the float contributes intimately and strongly to the behavior of the center pressure, that is, to the location of the resultant wind force in flight.

Airworthiness demands that the form of the floats shall be as near stream-line as possible, that the weight shall be minimum, and the floats as few and small as practicable. These demands seriously conflict with the demands for seaworthiness, which require rugged construction, good planing qualities and ample reserve of buoyancy and stability.

Careful consideration of all the above features indicate a compromise about as follows:

(*a*) The form of the bottom of the floats must conform to the demands for good planing qualities.

(*b*) The form of the upper portion, or the back of the float, should be the best possible, aerodynamically, consistent with the demands for reserve of buoyancy and stability, while affording adequate means of attachment to the airplane structure, and contributing to as high a degree as possible to the strength of the float structure and the support of the bottom surface against the loads imposed in service.

The get-away speed, as well as the landing speed, should be suited to the minimum flying speed, which, from present indications, should not exceed about 45 miles per hour, in a calm, even though this seriously handicaps the high speed performance attainable. Of course, when water conditions permit, higher speeds may be used and the longitudinal control after planing is attained will permit of increased speed on the surface before taking the air, also a down wind course may require higher water speed before a flying speed is attained.

The get-away and landings should be possible regardless of the direction of the wind or of the sea, and this requires that there should be no danger of tipping sidewise, or of nosing under. The final point of contact on get-away, and the initial point of contact on landing, should be as nearly central as possible to avoid disturbing moments at this critical period. The attitude of the airplanes should be normal at such times and the controls should have ample power. It is very essential to avoid "porpoising," and heavy shocks to the floats or to the airplane at this stage, in which seaworthiness and airworthiness are closely related.

Up to this time the best results have been obtained in this country by the use of the ventilator step type V-bottom float, having the arched back type of construction. This is a fairly efficient stream-line form, and disposes of material of the floats to good advantage. It appears, however, that with such a form of float, a greater reserve of buoyancy is necessary in order to provide sufficient initial stability because of the more rapid disappearance of water line area and inertia on moderate inclination, than is the case with the more usual rectangular form of section. The skid form profile is very generally in use, and appears to be necessary. It should be noted that this form involves danger when landed too much by the nose, on account of the powerful influence of suction effects on curved lines. A number of accidents have undoubtedly occurred on this account, due to the pilots' ignorance of the danger present under these conditions.

It is believed the above indicates in a very general way the most important requirement of floats for airplanes. A form of float construction which has given satisfactory results, together with the reasons for arriving at certain features of the design outlined in this article, is being prepared and will appear in an early issue of AVIATION AND AERONAUTICAL ENGINEERING.

"The Rocky Mountain Scout"

By Captain V. E. Clark

Aviation Section, Signal Corps

In the development of types of military airplanes we, in America are confronted with certain new problems arising from conditions peculiar to this country. For instance, it appears that, in the event of an invasion from East or West, a great part of the operations would be conducted in mountainous and heavily wooded country,—the Alleghanies, the Sierras, or the Rockies.

In order to meet the demand, for aerial tactical reconnaissance over such terrain, there must be developed types of airplanes which would permit being landed *on ordinary country roads,* and in small rugged spaces. It may be that one type would answer both purposes.

An airplane to land in an ordinary country road, should be of very small spread, about twenty feet, say, in order to safely clear bushes, fences, banks, and telegraph lines. There are a number of things designers can do to obtain small spread without resorting to any but arrangements of the present standard. We shall not discuss the helicopter, although such an arrangement would be ideal for *climbing out* of small spaces.

In order to retain reasonable aspect ratio and minimize the longitudinal range of movement of center of pressure on the main planes, the sustaining area should be as small as will permit the necessary slow speed, discussed later. Therefore, the total weight should be low. This demands low weight of power plant. A radial air cooled motor of, say, eighty horsepower, is indicated. As the flights for tactical reconnaissance are to be comparatively short, the fuel weight will not be excessive, even with this inefficient motor.

Next, in order to minimize spread, the triplane, or even an arrangement of a greater number of foils, appears advisable.

In this type, performance will necessarily be sacrificed to obtain controllability and the proper degrees of stability. The landing speed should be, probably not over twenty-five miles an hour, to permit very short runs after touching the ground. It is quite probable that efforts to obtain controllability will result in such aerodynamic inefficiency that our high speed will be not over thirty-five miles an hour. A wing section giving a very high lift coefficient, such as the R. A. F. 3, is needed.

A slight but positive inherent tendency to roll up out of a side slip under all conditions will be produced by dihedral. By making the dihedral of the lower planes greater than those of the upper, greater bush clearance will be obtained.

All control surfaces will be very large and should have powerful moment arms. This means that the pilot must be expert. The pilot should be able, under all conditions, to over-control the stability efforts, especially the diving tendency at high angles of incidence. This, in combination with proper degrees of inherent lateral and directional statical and dynamical stability might render possible, an airplane susceptable of being brought down at very low speed, "fluttering like a dead leaf."

The landing gear should have such an arrangement of wheels that the points of contact with the ground form a rectangle, and the fore-and-aft intervals of this rectangle should be bridged by skids. The main rear outside wheels, nearly under the center of gravity, should be controlled by independent brakes, controlled from the seat, in order that the airplane may not only be stopped quickly, but also steered, by the pilot, by "braking" one wheel more than the other. The landing gear should be very rugged, with liberal shock absorbers, the strength here being great as compared to that of the wings, where factor of safety is sacrificed to reduce weight.

Fatal accidents with this type should be very few if the engine and fuel tanks are placed forward of the pilot and observer.

SUMMARY OF REQUIREMENTS

1. Short run after landing.
2. Narrow spread.
3. With elevator abandoned, there must be positive inherent longitudinal stability, statical and dynamical. Under this condition, the airplane should recover from a head dive, or nose over from a stall. Assume a flat gliding angle, such that the speed will be the minimum necessary for action of control surfaces.
4. The elevator control should be so powerful that the tendency to nose over from a stall can be overcome to a reasonable extent and the machine held with axis horizontal so as to flutter down like a dead leaf.
5. The asymmetric stability at very high angle of incidence should be sufficiently positive to permit this last maneuver without turning over sidewise.
6. The landing gear should be of such design as to prevent serious injury to airplane structure in various kinds of rough landings.

It is urged that the development of such a type is a matter of very great military importance. It is suggested that, through such development, we would, along one line at least, have something ahead of any other army—something that would give us a distinct advantage when operating in rugged mountainous, wooded country, of which we have such great expanses.

Interesting Experiences of Military Aviators in Egypt

W. T. Massey has recently given an interesting account of the work of the Royal Flying Corps of Great Britain in the operations against Ali Dinar near Darfur, Egypt:

The airmen, who were detailed to act with Colonel Kelly against the Sultan Ali Dinar, had to move south at very short notice, and travel by sea, rail, and desert track for 2000 miles before they could reach the barren spot from which they were to operate. Though the natives were not astonished to see machines in the air, they were surprised beyond expression when men alighted from them. One who found speech was heard to say: "The government was always great, but now it is greater than ever."

On March 31, two officers left Suez for Port Sudan and Khartum, and they were followed on April 7 by an advance party of a few officers and men. Intense heat caused aviation petrol tins to burst, and evaporation was so great that a consignment of seven cases supposed to hold 56 gallons contained only 37 gallons. Plants with very sharp, hard thorns grew on the track and punctured tires, and, with the thermometer 120 degrees in the shade, it was desperately hard work to get up stores to be ready for the commencement of aerial flights from Hilla by May 12. Most of the transport was done with camels.

An officer traveling in advance had selected spots for landing places, and had put down directional arrows of long strips of white cloth. These began to disappear, and the new robes of sheikhs' wives was evidence of the uses to which the pilfered material had been put. It was extremely difficult to find one's way in this country. A reconnoissance had been arranged for May 12, and a machine flew over El Fasher, the capital of Darfur, on that morning. The Royal Flying corps had kept to the time-table, despite the unexpected difficulties of the road, and all that was asked of the flight was done to the end.

On May 17 Colonel Kelly's force was approaching Bir Meleit, an oasis 37 miles north of El Fasher, which was believed to be occupied by the enemy. At dawn an airman started from Hilla, 116 miles away, to reconnoiter. On his first journey he could not find Meleit, and he returned to the aerodrome at Hilla. At 8:45 a.m. he again set out, and was successful. In flying over the place he was fired at, and a bullet hit the propeller. Bombs were dropped, and the airman came down low and opened machine-gun fire on the enemy, 500 of whom bolted and left Meleit. On his return journey the airman dropped a message to Colonel Kelly, telling him that there was water in the wells and that the enemy had fled.

On May 23, as Colonel Kelly was approaching El Fasher, Lieut. J. C. Slessor flew over the long stretch of country between the aerodome and Ali Dinar's capital, and arrived at the moment when the force had gained a victory over the Sultan's troops. Lieutenant Slessor saw 2000 enemy cavalry drawn up in reserve outside the town, and attacked them with bombs and machine-gun fire. The horsemen scattered in all directions and took no further part in the fighting. When he began bombing the cavalry the lieutenant saw a group surrounding a banner. He aimed a bomb at the party, and later information points to the Sultan having a narrow escape, two of his servants and his own camel being killed by the bomb. While attacking the cavalry Lieutenant Slessor received a bullet wound in the thigh, and he had to steer with his hand instead of his foot on his way back to Hilla. He brought the first news of the victory, and it was transmitted to the Sirdar from the aerodrome.

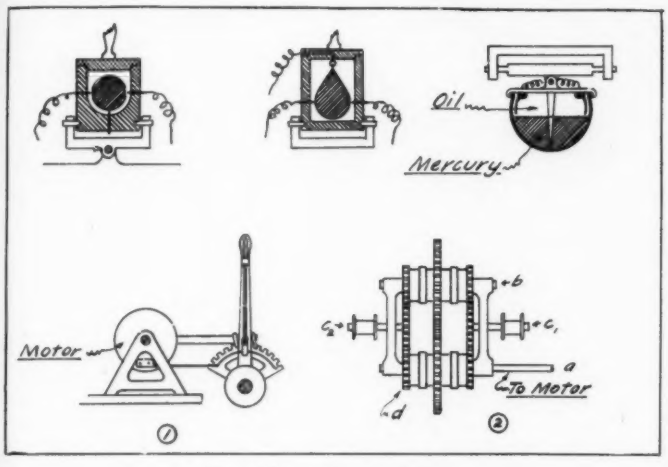
Macy Stabilizer Patents

By W. B. Ford

The Macy stabilizer as presented in four Patent Office reports is a gravity controlled "stabilizer" unit affected by the tilting of the airplane and which, by operating the aileron and elevator surfaces, brings the airplane back to its normal position.

The stabilizer in its simplest form is merely a metal sphere which fits loosely in an insulating hollow cylinder. This sphere rests on a pin which forms an electrical contact. Level with the center and at right angles corresponding to the longitudinal and transverse axes, the surface is flattened to receive four electrical contacts projecting through the cylinder and nearly touching the sphere. A slot and pin keep the sphere from rotating about its bearing.

The operation of the device is as follows: If the airplane starts to dive, the ball rolls forward, due to the tilting of the container, completing the electric circuit through the forward pin in the cylinder and thus starting the mechanism which operates the elevators. A like action would result for lateral displacement. A combination of pitching and rolling would cause two contacts to be closed, thus operating the elevators and ailerons simultaneously.



THE MACY STABILIZER

This type of stabilizer has two slight variations in which the oscillating part is pear shaped. In one case the pear is supported on its sharp end and acts as the sphere does and in the other case it is hung on a universal joint at the small end from the top of the chamber. All of these types are so mounted that they can be set at any initial angle by a handle attached to the top of the insulating cylinder thus making it possible to keep the airplane at any angle of dive or climb or bank and, with the proper adjustment of the rudder, a spiral dive can be accomplished.

The other type of stabilizer consists of an insulating semi-spherical bowl hung by a universal joint which is prevented from swinging freely by a system of gearing whereby the bowl can be set at any initial angle. This bowl is nearly filled with mercury and oil in about equal proportions. A single spindle extends from the cover which seals the bowl, through the oil, well into the mercury, thus forming a continuous electric connection between the cover and the mercury.

Since the bowl is not free to turn in its joint, any tilting of the airplane will cause a change in the level of the mercury which is taken advantage of to control the machine which operates the surfaces. In one case four spindles at right angles to each other and in line with the axes of the airplane extend from the cover of the bowl, from which they are insulated, nearly to the mercury which they touch when the airplane tilts. A somewhat complicated system of brushes carries the current from these four spindles and the center one through the bearings out of the apparatus.

In the other case, the central contact is brought up through the bottom and the other contacts through the side of the bowl, and wires are connected directly to them without any brushes. It is obvious that, when the airplane tilts, the mercury level will rise on one side, completing the circuit and causing the surface mechanism to operate.

One fault which one would expect to find in these types of controls is that sudden accelerations will cause an oscillation of the pendulum or liquid and result in a false operation of the surfaces. It is claimed for these devices that these accelerations cause such short-lived effect that the lag of the apparatus makes them negligible.

The simplest form of machine to operate the surfaces is shown first in the diagram. It is intended to be used with the old style of lever control and consists of electric motors mounted in line with worm segments fastened to each control lever. The motor shaft is fitted with a worm engaging with the segment on the lever. As the stabilizing unit is affected, it starts the motor which automatically operates the control levers. Current for these motors is secured from a storage battery or any other suitable source.

In order to release the controls from the effect of the stabilizer, the motors are swiveled and connected with the levers in such a way that by simply grabbing the handle a grip is closed which lifts the worm off the segment, thus allowing the levers to be used independently of automatic machinery.

The other two types of operating machines use electric magnetic clutches to engage different gears which control the surfaces. These clutches work as follows:

Four magnets are mounted on a disk which is continuously rotating with a shaft connected to the airplane engine. The ends of these magnets are fitted with wedge shaped teeth arranged in radii from the center line of the shaft. Mounted to slide on the same shaft is another disk fitted with teeth corresponding to those on the magnets. The magnets are connected with the stabilizing device and a completion of the circuit there causes the magnets to pull the two disks together, thus engaging the teeth and making the two rotate as one unit. When the magnets cease to pull, the wedge shape of the teeth causes them to disengage. The sliding disk is fitted with a gear which meshes with one on a drum to pull the control cables. The clutch unit is entirely inclosed by a cylindrical box.

The two types of machines differ only in the arrangement of the parts. In the first case, shown as *2* in the diagram, the motor shaft is connected with shaft *a* which has a central gear mounted on it. This central gear is in perpetual mesh with a corresponding gear on shaft *b*. Thus the two gears are always turning when the engine is running. On both sides of each gear is mounted the magnet portion of the clutch, with the sliding portion *d* outside. Between shafts *a* and *b* are two shafts, c_1 and c_2, fitted with drums and gears which mesh with the gears on the sliding disks.

Assuming that the drum on c_1 operates the aileron cables, the action would be as follows: When the airplane rolls to the right, the right hand circuit in the stabilizer is completed, causing one of the clutches, for instance on *a*, to close. Then the drum will rotate in such a manner as to cause the ailerons to give a righting effect. If the airplane rolls in the opposite direction, the opposite clutch on *b* will close, causing the drum to rotate in the opposite direction and again righting the machine.

In the second case, the only difference is in the fact that the drums are mounted to be at right angles to each other. This necessitates two units as if the first case was cut in half at the center gears and swung at right angles. The action is identical and needs no further explanation.

Both these devices are designed to be released from the hand controls by breaking the electric circuits when the controls are gripped, thus preventing the stabilizer from closing the clutches.

Book Reviews

THE AVIATION POCKET-BOOK, 1916

By R. Borlace Mathews

(Crosby, Lockwood & Son, London. $1.00. Pp. 176)

The fourth edition of the pocket-book which was first published in 1913, contains a large amount of information. Divisions are devoted to the pressure and resistance, airplane theory and design, structural materials, engines, examples of actual machines, piloting and aerial navigation, metreological data, military information and signalling, etc. The volume is excellently printed and the information is clearly presented, and should find a place in aeronautical engineers' libraries.

Course in Aerodynamics and Airplane Design*

By Alexander Klemin, A.C.G.I., B.Sc., S.M.

Instructor in Aeronautics, Massachusetts Institute of Technology, Member of the Aeronautical Society of Great Britain and Ireland

and

T. H. Huff, S.B.

Instructor in Aeronautics, Massachusetts Institute of Technology

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PART 1—SECTION 12

Resistance and Performance

Nomenclature

It may be useful to restate the symbols which we employ in considering performance curves, ascent and descent.

W = weight of the machine.
A = area of the wings.
i = angle of incidence of the wings.
L = lift.
K_y = lift coefficient.
D = drag of wings.
K_x = drag coefficient.
R = resultant of lift and drag on the wings.
P = parasite or structural resistance of a machine.
D_t = total resistance or drag $= D + P$.
R_t = total resultant air force on a machine.
H = propeller thrust.
θ = angle of flight path with the horizontal.

Structural and Wing Resistance for the British B.E.2

In Section 4 of the Course, a problem was worked out on the sustentation and resistance of wing surfaces, which in spite of some rough assumptions, illustrated the main performance

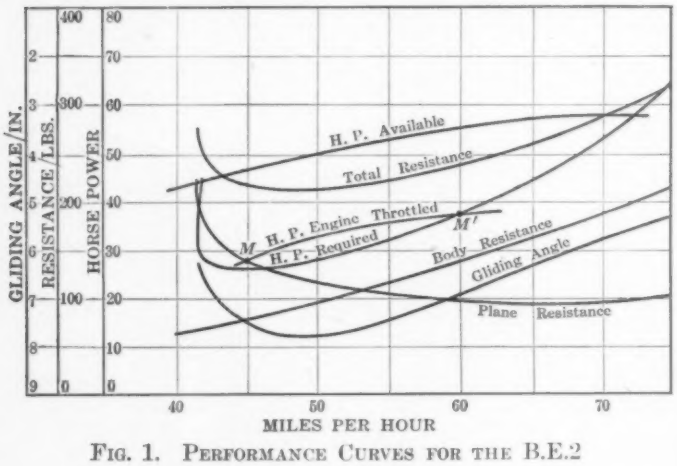


FIG. 1. PERFORMANCE CURVES FOR THE B.E.2

curves and calculations employed. In Fig. 1 are shown curves for the British B. E. 2. It is not a particularly modern machine, but has been worked out so thoroughly that it deserves particularly careful study.

The body or parasite resistance which includes the resistance of the wing bracing, chassis, etc., as well as the resistance of the body proper, is taken as varying as V^2 and allowance has been made for propeller slip stream velocity. The body resistance is seen to play an unimportant part at low speeds. But at about 53 miles per hour it becomes greater than the plane or wing resistance, and at high speeds it is almost twice as great as the wing resistance. This emphasizes the importance of minimizing the resistance for a high-speed machine. However good a wing section itself may be, high structural resistance will make high speeds impossible.

The plane resistance curve has a minimum value at about 62.5 miles per hour and increases on either side of this speed. It is interesting to follow out how this increase in resistance on either side occurs. At high speeds, the angles of incidence and the drift coefficients are small but the speeds are very great, and the increase in wing resistance is obvious. At small speeds on the other hand the airplane is flying at large angles of incidence to give the necessary sustentation and

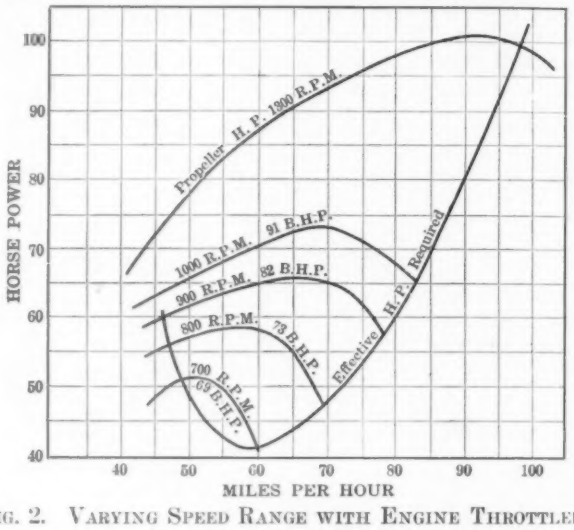


FIG. 2. VARYING SPEED RANGE WITH ENGINE THROTTLED

the drift coefficients are large. The shape of the total resistance curve follows from the summation of the two.

Theoretical Laws for Minimum Thrust and Minimum Horsepower

From a theoretical treatment of the question, the following interest law has been derived:

Minimum thrust is required to overcome the resistance of an airplane when the parasite resistance is equal to the drag.

For a proof of this law, reference to Chassériaud and Espitallier is appended. In the case we have selected, illustrated in Fig. 1, the structural air resistance and the wing drag are equal at a speed of 52 miles an hour, while the minimum resistance is at 50 miles per hour. The law does not seem to be borne out by practice, though it may be occasionally useful as a rough check.

The minimum horsepower required generally occurs at a low speed, but not at the minimum speed; and its position will vary for every machine. Another theoretically deduced law states that:

Minimum horsepower is required when the machine is moving at a speed at which the wing resistance is three times the body resistance.

This law is often highly inaccurate, but may be useful.

Effective or Propeller Horsepower Available Curve

Typical curves for these are also illustrated in Fig. 1, and are of the greatest interest to the designer. In establishing such curves it is generally assumed that the engine is running at the rated revolutions per minute and that in designing the propeller the efficiency for this revolution per minute at every airplane speed is known. Thus assuming an engine which delivers 140 horsepower at an airplane speed of 80 miles an hour, the propeller having an efficiency of 75 per cent at this speed, the available horsepower will be

$$\frac{140 \times 75}{100} = 105 \text{ horsepower.}$$

* This Course commenced in the August 1, 1916 issue of AVIATION AND AERONAUTICAL ENGINEERING, will be completed in 24 issues. It will embody the fundamental aeronautical data necessary for airplane design, and present the design of standard machines in complete, simple and systematic form.

Since the power of a propeller is given by the product of its thrust into the speed and the speed of the propeller is the speed of the airplane, it follows that when the propeller is delivering sufficient power, it is also delivering sufficient thrust. Hence propeller horsepower available is sufficient for all practical consideration, and propeller thrust curves need not be included in a performance chart.

Minimum and Maximum Speed; Maximum Excess Power; Best Climb; Descent

The maximum and minimum speeds of an airplane are generally given by the two points of intersection of the propeller horsepower available and the total horsepower required. If the machine is highly-powered, and the propeller efficient, the two curves may not intersect at the speed at which the lift becomes insufficient, and the airplane would climb at stalling

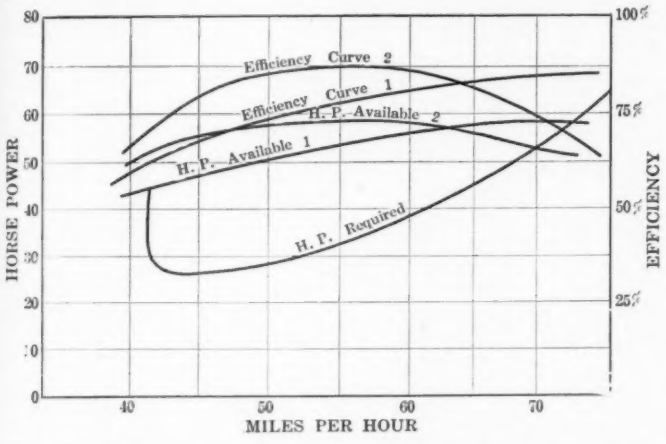


FIG. 3. VARIATION OF PERFORMANCE WITH CHANGE IN PROPELLER DESIGN

angle, unless the engine is considerably throttled down. The climb decreases the angle of incidence, and checks stalling. It is thus a decided advantage to have excess available power at high angles.

It is a simple matter to deduce the speed of climb from the excess power. This is absorbed in raising the machine.

$$\text{Excess power} = \frac{\text{Total weight} \times \text{climb per second}}{500}$$

The maximum excess power does not occur at the lowest speed. To find it, we must measure the maximum ordinate between the available propeller horsepower and the total required horsepower. In Fig. 1 this is to be found at 48 miles per hour. The excess is 21 horsepower and the weight of the machine is 1650 pounds.

$$\text{Climb} = \frac{21 \times 550}{1650} = 7 \text{ feet per second or } 420 \text{ feet per minute.}$$

This is, however, only the initial rate of climb. As the machine rises, the density of the air, the power of the engine, and the climb gradually diminish.

In practice, the pilot need not know the change of incidence that he produces to climb, although for a given machine it is an easy matter to calculate the correct angle from the performance curves. In Dr. Hunsaker's words, "a careful man moves his elevator slowly until he has placed himself on the desired trajectory." Part of the art of aviation is to do this without exceeding safe limits, for obviously there is a limit to the rate of climb the engine can handle. If the machine is put on a climb too steep for the power of the machine, the speed is suddenly lost, the controls become ineffective, and the machine has stalled.

In descent, very analogous considerations obtain. The pilot decreases his angle of incidence to a negative value. At this angle the speed required for sustentation is beyond that of the maximum, and the propeller horsepower is insufficient. If D = deficiency in horsepower,

$$D = \frac{\text{Total weight} \times \text{velocity of descent.}}{550}$$

The machine descends and gains the required speed under the action of gravity.

The Two Regions of Control. Control by Throttling

Consider the performance curves of the same machine, the British B.E.2 shown in Fig. 1. Suppose the machine to be flown at 10 degrees at the point M with the engine throttled, so that there is equilibrium, and the power curve is as shown, 26 horsepower. The pilot wishing to rise will naturally increase his angle of incidence to say 12 degrees. He will then require 30 horsepower while the throttled engine will deliver even less than the 26 horsepower through the propeller. Instead of rising the machine will fall.

Suppose now that flying at the same point and under the same conditions he wishes to descend, and decreases his angle to 8 degrees. He will now have an excess of power of 3 horsepower as can be seen from the curves and will ascend instead of descend. There is therefore a region of reverse controls, known to French authors as the *régime lent.*

At the point M^1, when the pilot wishes to rise and increases his angle of incidence, he does indeed obtain excess power and rises. Here the controls are normal and the region is known as *régime rapide.* For an inexperienced pilot the *régime lent* is dangerous. Even if he knows the angle of incidence at which he is working, he is likely to get into difficulties.

With a flexible engine, an expert pilot can operate an airplane in the slow speed region by manipulation of the throttle alone. In Fig. 2 the propeller horsepower available is shown with the engine throttled down to various speeds for a design taken from Dr. Hunsaker's pamphlet, to which reference is appended. For each speed of the engine there is a different maximum and minimum speed, and a different speed range. If the airplane is flying at the minimum speed in the *régime lent* region at a certain revolution per minute, the pilot can by unthrottling his engine pass to a larger speed range, obtain excess power and climb without changing his forward speed or angle of incidence. When an engine is throttled the danger of reversed controls is still greater, because the speed range becomes so very small. Even the best of pilots may mistake his position on the curve.

In French airplane contests, a premium has been placed on low speeds, and the *régime lent* with throttling has been largely and successfully used. Such operation does not seem advisable for ordinary flying.

Variations in Propeller Horsepower Curves

We will now consider the possible variations in performance by changing the design of the propeller from a high speed to

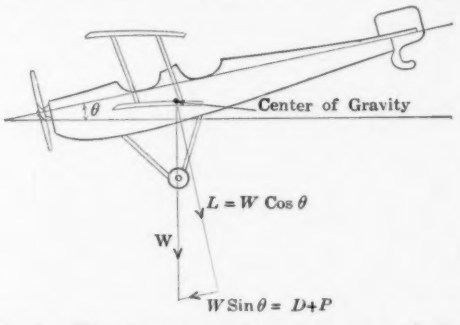


FIG. 4. FORCES ON AN AIRPLANE IN A GLIDE

a climbing propeller. In Fig. 3 the B.E.2 is again illustrated. The power required curve remains the same. By suitable design the propeller efficiency curve can be changed so as to give maximum efficiency at varying speeds. The design of a suitable propeller cannot unfortunately be detailed here.

For the propeller with Efficiency Curve 1, the maximum efficiency is at high speed, and the Horsepower Available Curve 1 shows that such a propeller will give a high maximum speed. It is a high speed propeller when applied to this particular airplane.

For the propeller with Efficiency Curve 2, the maximum efficiency occurs at a lower speed. Such a propeller will give a smaller maximum speed, as can be seen from Horsepower Available Curve 2, but a greater excess power. It will be a climbing propeller. There are many such variations possible for any machine.

Angle of Glide

The best L/D for a wing section may be in the neighbor-

hood of 14 or 15. But the parasite resistance of a machine, *i. e.*, the resistance of the body, wing bracing, etc., increases the drag to such an extent that the L/D_t of the whole machine may be reduced to 7 or 8. It is this value of L/D_t which determines the angle of glide of a machine.

In Fig. 4 is shown a machine which is gliding with the engine shut down so that the propeller exerts no thrust, i being the angle of incidence, and θ the angle which the machine makes with the horizontal line being the angle of glide. Resolving forces perpendicular to and along the line of motion, the equations of equilibrium for steady glide are:

$$W \cos \theta = L \qquad (1)$$
$$W \sin \theta = D_t = D + P \qquad (2)$$

The angle of glide is therefore given by the equation

$$\tan \theta = \frac{D_t}{L} \qquad (3)$$

and has its minimum value when D_t is a maximum.

The minimum angle of glide is also termed the "best" angle of glide. At a given height above the ground, the forward displacement of the machine before landing varies as cos θ and will be a maximum for the smallest value of θ. The pilot has at this angle the greatest radius of action when descending from a height with his engine shut off.

The angle of glide for any machine at any speed can be at once obtained from the total resistance curve for D_t and the weight of the machine, assuming $L = W$ which makes a comparatively small error. In Fig. 1, the angle of glide is shown for all speeds of the machine in question.

References for Section 12

Barnwell's Aeroplane Design.
Aeroplane Design by J. C. Hunsaker, United States Naval Institute Proceedings, November-December, 1914.
British Report, 1912-1913. No. 86.
Chassériaud et Espitallier, Cours d'Aviation.

Army and Navy to Build a Zeppelin

Decision to undertake immediately the construction of a large rigid airship of the general Zeppelin type was announced to-day by Secretary of the Navy Daniels and Secretary of War Baker, as the result of the recommendations of a joint army and navy board, which has been studying the problem. Here is the official announcement:

"A joint committee of army and navy officers representing the aeronautical branches of both services, the General Staff of the army and the General Board of the navy, after a study of the question of rigid airships, has recommended that the construction of a large airship on the general Zeppelin type be undertaken at once under the direction of the chief constructor of the navy, and has also recommended that to successfully prosecute this work and secure the most effective co-operation a joint technical board, composed of the chief constructor of the navy, as senior member, and three officers from each of the two services as members, be appointed.

"These recommendations have been approved by the Secretary of War and the Secretary of the Navy, and plans for undertaking this work immediately are being worked out. The cost of construction will be borne equally by the army and the navy from appropriations made by the Sixty-fourth Congress.

"The importance of the rigid airship for military and naval purposes is fully realized, and it is believed that the problems involved can be worked out better, more rapidly and more economically by joint action than if each service took them up separately."

The Army Aviation School at Hampton

The United States Army aviation school and experimental station will be established on Back River, near Hampton, Va., 1169 acres of land having been purchased at $290,000 for the site. This property is located 1¾ miles from Hampton, and it is stated that contracts will soon be awarded for buildings costing about $1,500,000, to be followed by other structures, etc., increasing the expenditures to several million dollars.

Memorial Tablet to Lieut. R. C. Saufley

A tablet to the memory of Lieut. Richard Caswell Saufley, who was killed at Pensacola, Fla., will be erected by the members of the 1908 class of Annapolis, of which Lieut. Saufley was a member. The Capitol Commission has been asked for permission to place a replica of the tablet in the State Capitol at Frankfort, Ky.

POWER REQUIRED IN SEARCHLIGHTS FOR NIGHT FLYING

By Archibald Black, of the L. W. F. Co.

In the December 15 issue of AVIATION, in an article describing the report of Lieutenant Dargue, instructor in flying at the North Island station, San Diego, Cal., the statement is made that "He does not believe that the efficiency of the airplane motor should be impaired for propelling purposes by utilizing a part of its power to generate current for lighting."

As considerably more power is required when the generator is driven by a special air turbine, it is probable that the lieutenant has been quoted incorrectly in this.

I do not happen to know the current required to operate the searchlights used on the machines at the San Diego station, but Lawrence Sperry is reported to have used, in his night flights, a 150-watt equipment, and, although this seems very small, we may assume that it is sufficient. From this we find that the horsepower required to operate the lighting equipment is $\frac{150}{746 \times .75} = .268$ horsepower where the overall efficiency of the generator is assumed to be 75 per cent.

Where the generator is driven direct from the motor this .268 horsepower is the actual power required. Where the generator is driven by an airscrew we have a loss of approximately twenty-five per cent., depending upon speed and design of screw, in the transmission of energy from the motor to the moving airplane, and a further loss on a conservative basis of at least 25 per cent. in the transmission of energy from the airplane to the generator by means of the air turbine drive. Thus efficiency of drive from motor to generator $= .75 \times .75 = .5625$; consequently, loss here is 43.75 per cent. and horsepower required to furnish 150 watts is $\frac{.268}{.5625} = .476$ horsepower as against .268 horsepower found above for direct drive.

However, this loss in energy is so small in comparison to the horsepower of our motor that it is more than offset by the advantage, with the air-screw drive, of being able to generate current for lighting while in a glide with the motor stalled or throttled down.

Yale's Aviation Plans

Trubee Davision, president of the Yale Aero Club, has induced about all the members to become prospective members of the school of aviation to be established next Spring by the American Trans-Oceanic Company at some point on the northern shore of Long Island Sound, probably at either New Haven or New London. There are a score of members of the club who are competent aviators at present who go to New London two or three times a week and practice with the Government flying boats located there. Several will take a course at the new school to perfect themselves as military observers and aerial photographers.

Part of the Hall-Scott Motor Car Company's factory, West Berkeley, Cal., showing main office, stock room, inside and outside testing departments. The company is producing 15 engines a week.

Annual Meeting of the Society of Automobile Engineers

At the annual meeting of the S. A. E., held in New York on January 11, it unanimously decided to change the name of the society to The Society of Automotive Engineers.

THE STANDARDS COMMITTEE REPORT

Preceding the meeting of the Society, the S. A. E. Standards Committee met on January 8 and 9. At this meeting there were present the following: H. M. Crane, F. S. Duesenberg, L. M. Griffith, Spencer Heath, J. G. Vincent, A. C. Woodbury, Recorder; C. B. King representing Henry Souther and F. W. Caldwell representing Capt. V. E. Clark. The visitors present were Clarence Carson, A. Champion, V. W. Kliesrath and J. G. Utz.

The following report was given out by the committee:

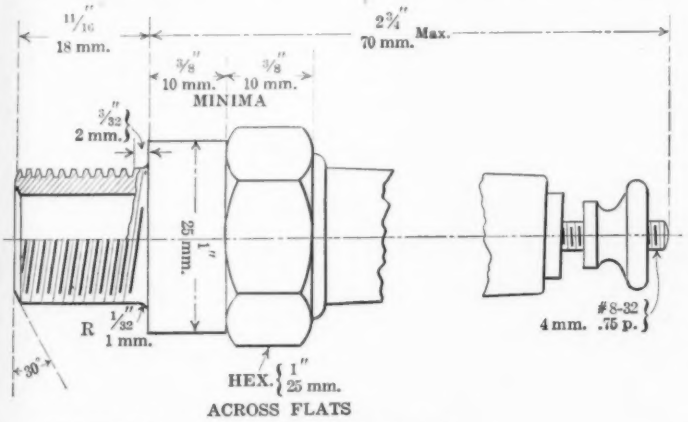
SPARK PLUG SIZE

At the October Meeting of the Standards Committee this Division reported in favor of recommending spark plugs having 18 mm. threads for use with aeronautic engines. This report was approved by the Standards Committee but was referred back to the Division by the Council, asking for more complete detail dimensions.

Accordingly the Division has prepared dimensions as shown on the sketch presented herewith. The thread dimensions correspond with those adopted in Great Britain by the Engineering Standards Committee. No limits have been placed on the pitch diameter of the thread by the Engineering Standards Committee.

Considerable discussion developed on the question of whether metric or English dimensions should be used. In spite of a vote in favor of metric dimensions at the October meeting of the Division, several of the members were reluctant to adopt them. It was thought that the question was one of too great importance to be decided out of hand in a Division meeting, and that it should be discussed and decided by the Standards Committee or the Council or both.

In order that the proposed standard for spark plugs might be placed on record, dimensions in both millimeters and inches have been provided, the closeness of the equivalents being determined by the degree of accuracy required in the different dimensions.



ACROSS FLATS

16.9 Threads per inch: 1.5 millimeters pitch.
Root diameter .633 inch: 16.09 millimeters.
Pitch diamcter .678± inch: 17.22± .02 millimeters.
Outside diameter .717 inch: 18.2 millimeters.

STANDARD S. A. E. SPARK PLUG

The design follows the same general lines as the S. A. E. large hexagonal plug, but the gasket seat and size of hexagon are 25 millimeters (approximately 1 inch) instead of 1⅛ inches, this giving an ample gasket seat in connection with the 18 millimeters thread.

In addition to the dimensions given in the present S. A. E. standard for spark plug with ⅞ inches thread, a limiting dimension has been placed on the height of the plug above the gasket seat, and a definite dimension has been given from the gasket seat to the lower end of the spark plug shell.

In connection with the proposed spark plug standard the Division recommends that in every case the tapped hole into which the spark plug is screwed should be counterbored slightly to approximately the outside diameter of the thread.

ENGINE SUPPORTS

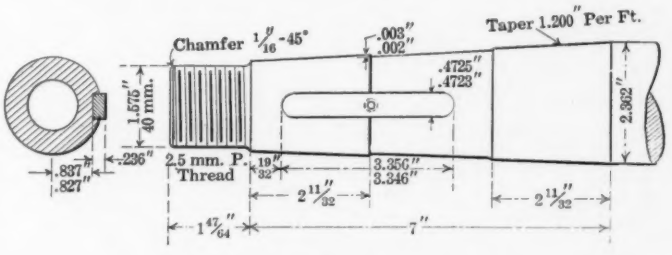
The Division recommends three sets of dimensions for bed timbers for supporting engines and airplanes. No standardization is thought possible in regard to fore and aft length. The dimensions recommended are as follows in inches:

Distance between timbers.....	12	14	16
Width of bed timbers.....	1-½	1-¾	2
Distance beween centers of bolts	13-½	15-¾	18

PROPELLER HUB DIMENSIONS

At the October meeting of the Standards Committee, the Division proposed for acceptance a tapered shaft end for mounting propeller hubs, but this proposal was not voted upon. Since that time additional reports have been received from France and from New Mexico, to the effect that the tapered and keyed fitting for propeller hubs is giving perfect satisfaction.

The Division therefore submits for adoption as recommended practice, practically the same dimensions as were submitted



STANDARD S. A. E. PROPELLER HUB

at the October meeting, the only difference being that the proportion of the tapered length to be relieved has been reduced somewhat. The proposal is outlined in the sketch presented herewith. Most of the dimensions are given in the English equivalents of the metric dimensions used in France, but may be translated back to metric dimensions if this policy shall be preferred.

The Division is not prepared yet to recommend dimensions for hub flanges, etc., but the Aviation Section of the Signal Corps will submit drawings suggesting different sizes of hubs.

DIRECTION OF ENGINE ROTATION

At the October Meeting of the Standards Committee the Division reported definitions of terms for direction of engine rotation. The National Advisory Committee for Aeronautics did not concur in these definitions in its report on nomenclature, and since printing that report has revised its own first definitions.

Because of lack of agreement with the National Advisory Committee, the Council of the Society referred the definitions back to the Division. The Division has reconsidered the matter and is not thoroughly satisfied with any of the definitions proposed. It has accordingly prepared new definitions for direction of engine rotation, making use of the terms "normal" and "anti-normal" in place of the terms which have formerly been used and have caused confusion, are not to be reported to the Society at the present time but are to be submitted to the National Advisory Board in order to secure agreement if possible before further definite action is taken.

THE S. A. E. MEETING

On the day of the meeting three sessions were held. In the morning, at the business meeting, reports of officers, the election of new officers and reports of committees were presented. President Huff, in his annual address, reported the great growth that had taken place in membership, and outlined the great possibilities of the Society under the new plan of including tractor, marine and aeronautic engineers in the organization.

After a buffet lunch, the technical session was held for a discussion of the papers presented. Captain V. E. Clark explained the remarkable moving pictures of foreign and American airplanes, as well as replying to questions concerning his paper.

ANNUAL DINNER

Over 800 engineers in the aeronautical, motor car and motor tractor fields attended the banquet held on January 11, at the Hotel Biltmore.

Dr. Stratton, of the Bureau of Standards, and Colonel Baker, of the Quartermaster's Corps of the War Department, were seated at the speakers' table. The speakers were: The Honorable John Barrett, on the subject of Pan-Americanism, and H. E. Coffin, on Industrial Preparedness. Mr. Coffin said in part:

As I see it, this banquet provides a fitting ending, a climax if you please, for the most eventful and most useful year of the existence of your Society. One year ago this organization was a live and most progressive engineering society, dealing with the problem of one of the world's greatest industries. In co-operation and in unselfish effort for the common good in the advancement of the motor car art we had become a recognized example to all the technical bodies of the world. Most great industries are accounted young at the half century mark of their existence. I will leave to your imagination the picture of the "Automotive" business in 1950. But remember this—the American Society of Automotive Engineers is building to-day the foundations upon which must rest that structure of 1950.

Two years and a half ago our duty was to a single industry, and our activities were restricted within that field. The European war has changed all this. Our greatest duty to-day is to the country to which we owe so much. The old order of things is gone, and gone forever.

Every other first-class power of the world will emerge from this great struggle a new nation. To talk of exhaustion in the industrial sense is foolish. Great Britain with five millions of her industrial workers in her armies is producing far more manufactured goods than ever before in her history. In European countries all orderly methods of precedent have of necessity been shattered. Revolutions in governmental and industrial relations have been forced to meet the necessities of war, but these relations will endure and will sooner or later determine the commercial supremacy of the world. But you may ask how all this affects the work and the future of this technical body. Let me touch for a moment on some phases of the vast movement of which we gradually are becoming a part.

The name of this organization appears in the annual report of the Secretary of War. This Society has become a national institution, not in geography, but in service. Its governmental relations will become closer month by month, and more varied. Its part in the general scheme for the national defense is a vital one. The broad plans, the almost dreams, of a few months ago have become realities. The "Automotive" combination is practically an accomplished fact. Through aircraft, through motor vehicle development, through the motor tractor and the motor boat we touch the Governmental Departments, and through them the vital life of the nation in a dozen points.

Restricting our thought to the military and naval aspects of the situation, we find every agency of defense and of offense dependent at some point on the work of the Society of Automotive Engineers. We must supply the eyes without which any modern army or fleet has become useless. We must supply the scouts and the fighting machines for land, air and water.

Under the new order of things military, every member of this Society is eligible for a War Department commission in the Officers Reserve. We already have Major Souther, Major Hutton, Major Waldon and perhaps others. Our plan of organization for standards work and our accomplishments in this field have been made the basis for much of the work of the Naval Consulting Board and of the newly created Council of National Defense. I will not attempt to make predictions for the future.

Technical Staff of Bureau of Construction and Repair

The Bureau of Construction and Repair of the Navy Department has started the new year by expanding its technical staff. Chief Constructor D. W. Taylor now has as his assistants, whose time is entirely devoted to aeronautics, the following:

Naval Constructor Richardson, at Pensacola, in charge of experimental building, repair and maintenance of aircraft at that station.

Naval Contractor Westervelt, at Buffalo, "Superintending Constructor of Aircraft," who is to control the inspection of aircraft built on contract and to represent the Bureau in the field.

Assistant Naval Constructor Hunsaker, at Washington, assistant to the chief constructor, in charge of design specifications and contracts.

Dr. A. F. Zahm, at Washington, in charge of wind tunnel experiments and on research work of the Bureau.

A NEAR VIEW OF FRENCH AVIATORS

By Robert Glendinning

Any one going to France at this time, who has visited that country in previous years under different circumstances, must necessarily feel a certain depression, and share with the whole country the sorrow and grief and suffering which has been brought to its door. And yet, with all their losses, the French people are wonderfully cheerful, and look upon the war as a misfortune which was inevitably thrust upon them and which must be philosophically borne to the end.

Having just returned, and having been favored with a card from the Minister of War, which permitted not only admission to several of the aviation schools, but also a visit to the front on the Somme, where the activities a few weeks ago were conspicuous, it would seem, a few words regarding our "wonderful boys" in the Foreign Flying Corps might be interesting to those who have friends there.

It may be stated without fear of contradiction that the French are without doubt the leaders in the air, and from the impression received they are likely to continue to hold it and, if anything, improve the science of flying more rapidly than any other country. Their whole system of teaching is totally different from ours; they begin with a student alone in a machine, instead of the method employed in this country of having a student start with an instructor in a machine of dual control.

Their work of teaching is more costly, as many machines are destroyed as a result of carelessness or accidents, but a student will necessarily become very much more self-reliant and have more confidence if alone, than if dependent on his instructor for assistance under any unusual condition. They have innumerable schools all over the country, the most important of which is located near Versailles, at Buk. It is a common sight to see the beginners starting out there in machines called "Penguins," which are a form of Bleriot type monoplane, with wings about six feet wide, which do not permit the machine to rise off the ground, but which attain a speed of about fifty miles an hour, and which are given to students to teach them to fly in a straight line.

When the students become proficient they are advanced to a monoplane of sufficient power to permit a rise of about six feet, and in these machines they are compelled to make sixty to seventy-five landings; they are then promoted to a higher-powered machine and taught the art of turning in the air and landing from a height of about fifty feet. Later in his course the student is compelled to execute spirals; remain in the air at least an hour at an altitude of two thousand meters (about seven thousand feet); take a cross-country flight of two hundred and forty kilometers (about one hundred and fifty miles); and when he graduates from this school he is sent to Caseau, where he is taught shooting and the handling of machine guns.

If a student is sufficiently apt he will go from there to Pau, where he gets a finishing course to prepare him for the front. At this school the student is taught to dive; execute a tail-spin (which is a vertical drop, with the machine turning rapidly in the air, and very dangerous); looping the loop (without losing any altitude); flying upside down, and also actual battle practice of fighting machines in the air. This is done with smoking bullets, which have no serious effect. The latter is probably the most dangerous part of the course, and only the most proficient students are allowed to take this test.

There are several branches of the Aerial Corps: Fighting Machines (single man); Observation and Fighting Machines (with pilot and one or two gun men); Bomb Dropping Machines (larger and with two motors), and Photographic Machines, which have been wonderfully perfected.

Those who lack the highest skill are placed in other branches of the service, which are equally responsible, but do not require such extreme quickness and co-ordination.

The American Esquadrille, now stationed on the Somme, is composed of twelve men, two of whom were, a month ago, "aces" (men who had brought down five German machines in the French lines), and all of whom are very much liked and admired by our foreign friends. I can imagine nothing that would be more patriotic to one's own country or a finer example of loyalty to France than entering the Flying Corps and getting the benefit of an education in the air, which certainly could not be offered anywhere else in the world.

The Mineola-Philadelphia Flight

In the teeth of a bitter, wintry wind, twelve army aviators started to fly from Mineola to Philadelphia on December 30. Eight of these arrived at the Philadelphia Navy Yard, and the others, having trouble, were forced to descend before completing the trip. The machines that finished landed in the following order:

Lieutenant Coyle, of the New Hampshire National Guard, with a passenger, 11.34 a. m.; H. W. Blakeley, with C. H. Reynolds, passenger, 11.40 a. m.; "Tex" Millman, with S. A. Blair, 11.45 a. m.; Captain J. E. Carberry, Army Signal Corps, 11.50 a. m.; Lieutenant James E. Miller, New York, 11.52 a. m.; Lieutenant G. Osborne, 11.53 a. m.; Leonard Bonney, with Instructor Allen, 11.56 a. m.; Lieutenant E. W. Bagnell, with Sergeant E. A. Kreuss, 1.30 p. m.

The best time was made by Lieutenant Coyle and Corporal Salmon, who covered the distance of 115 miles in 97 minutes.

Lieutenant Norbert Carolin, with Lieutenant Wheaton as passenger, crashed into a fence at Deans, N. J., after motor trouble forced them to descend. Both planes of the machine were smashed, but the men escaped injury. Sergeant E. W. Noyes, with a passenger, descended on the outskirts of Monmouth Junction, N. J., without difficulty. Captain Raynal C. Bolling descended at Monmouth, N. J. Lieutenant Kilner and John B. Stetson, Jr., of Philadelphia, a passenger, abandoned the flight shortly after the start.

H. W. Blakeley, in landing at the League Island Navy Yard, struck a flagpole, and his machine hit the ground at a sharp angle. Its nose stuck fast in a little trench, but the pilot and his passenger were uninjured, and the machine was repaired in time for the return flight on the following day.

The pilots and the passengers were attired for the flight in specially warm costumes designed for cold-weather flying. These consisted of leather hoods, surmounted by a wooden head-dress, to protect the ears and heads; fur and leather gloves covered their hands; stiff pigskin puttees protected the legs, and leather suits were worn, but even with this protection the extreme cold was severely felt by all the fliers.

THE RETURN TRIP

Seven of the eight airplanes that reached Philadelphia left for the return trip on the following day, and five of them reached their destination without incident. Lieutenant Arthur Coyle and Sergeant Kruss were forced to descend on account of engine trouble. Lieutenant J. E. Miller was the first to reach the Mineola field, one hour and twenty-six minutes after starting. He was closely followed by Capt. J. E. Carberry of the U. S. Signal Corps and Sergeant Salmon. Leonard Bonney completed the flight in one hour and eighteen minutes, while W. H. Blakeley's time was one hour and twelve minutes.

Lieutenant Arthur Coyle, of the New Hampshire National Guard, was forced by engine trouble and a broken propeller to alight in the water at Princess Bay. He was completely drenched, but unhurt.

(C) *International Film Service.*

ARMY AVIATORS AND INSTRUCTORS READY FOR THE MINEOLA-PHILADELPHIA FLIGHT.

The Group Includes: Captain Joseph E. Carberry, Captain R. C. Bolling, Lieutenant J. E. Miller, Lieutenant W. G. Kilner, Lieutenant N. Carolin, Sergeant E. W. Noyes, Sergeant E. A. Kruss, Corporal H. H. Salmon, J. B. Stetson, Jr., G. Osborn, E. W. Bagnell, A. M. Coyle, P. C. (Tex) Millman, H. W. Blakeley and Leonard W. Bonney.

Report on Airplane Wireless Work at San Diego

The following report was recently made to the Aviation Section of the Signal Corps, Washington, D. C., by army officers stationed at San Diego, Cal. It deals with some successful radio-experiments recently carried on there, and is official:

On July 27, 1916, airplane No. 50 piloted by Sergeant Wm. Ocker, Signal Corps, and fitted with radio sending apparatus operated by Captain Culver flew from North Island to the Martin field near Los Angeles thence to over Santa Monica, sending radio signals and messages at about ten minute intervals which were received and copied at San Diego by Dr. R. O. Shelton assisted by Lieutenant Robertson, from the school. Maximum distance communicated, 119 miles, from Santa Monica to San Diego.

August 17, 1916, airplane No. 50 fitted with radio receiving set operated by Captain Culver, while in flight received signals and messages from station of Dr. R. O. Shelton (6SR) in San Diego over distance of eleven miles. On following day added a 20-mile sending set and in flight sent and received at will carrying on a running conversation with 6SR over distances up to eleven miles. On August 24th repeated this test in flight sending with a 20-mile sending set, sending and receiving at will up to 20 miles, and continued receiving up to 40 miles from San Diego. Machine was piloted by Sergeant Ocker.

On September 2, 1916, airplane No. 50 piloted by A. D. Smith and equipped with a 20 mile radio sending set operated by Lieutenant Robertson and airplane No. 51 piloted by Lieutenant Dargue and equipped with radio receiving set operated by Captain Culver demonstrated the possibility of communicating by radio from one airplane to another while both were in full flight. United States Congressman Kettner of California was an interested spectator. It was suggested to Mr. Kettner that he write a simple message and after Captain Culver had gone into the air hand it to Lieutenant Robertson who would go into the air and send it by radio to Captain Culver. The message read: "North Island makes new world record." Captain Culver received the message successfully then returned to the ground and handed it to Mr. Kettner before Lieutenant Robertson landed. During the transmission of the message the machines were some two miles apart and at somewhat less than a thousand feet altitude.

On October 27, 1916 airplane No. 50 piloted by A. D. Smith and fitted with radio sending set operated by Captain Culver, transmitted signals and messages at about ten minute intervals during flight from North Island via Martin field near Los Angeles to over Chatsworth, Cal., northwest from Los Angeles. These signals and messages were received and copied by Dr. R. O. Shelton at his 6SR station in San Diego, 140 miles from Chatsworth. He was assisted by First Class Sergeant Zimmerman from the school. This set was constructed at the school, weighs 45 pounds, is driven by an aerofan and delivers 250 watts at 500 cycles.

A load of 3,100,000 feet of Alaska spruce for airplane construction was recently shipped from Seattle, Wash.

Pensacola Notes

The arrival of the Navy dirigible is the chief event in the work of the aviation station, and much progress is being made in assembling the craft, with prospects of an early trial flight. Immediately upon arrival the dirigible was unpacked and housed in the floating hangar only recently completed, where all work is being done.

A large allotment from the navy appropriation has been made for the Pensacola Station and many improvements are being planned. One pressing need is additional hangar facilities, as the three permanent structures are taxed to capacity, as well as all other storage space. It is probable that some of the canvas hangars used before the larger and more modern structures were completed will be unpacked and erected to serve temporarily.

Under recent orders issued by the Secretary, a complete airplane is being constructed at the Station, designed by Lieutenant E. O. McDonald. Work has progressed rapidly on the machine and final flights are being looked forward to with more than usual interest.

Considerable activity has been apparent at the Station since the arrival of a new class of students, many of whom have gone into training. Daily flights are being made, some with maneuvers with the destroyer Roe, on aviation and neutrality duty in Pensacola Harbor.

Numerous balloon flights have been made by Lieutenant-Commander McCrary, as well as operations with the kite balloon at the Station.

Official announcement has been made of the change in commandants at the Station, Captain J. L. Hayne, of the Naval War College being ordered late in January to take the place of Captain Mustin, who has been in command of the Station since its establishment. The change was made, it is announced, under plans of the Navy Department for increasing the activities of the navy yard, placing the two branches under one officer, but placing a lower officer in direct supervision of the aeronautic station. Captain Mustin's assignment has not been published.

Major Foulois Explains Delay

Major B. D. Foulois, chief aviation officer of the southern department, has given out a statement explaining why work on the new aviation post to be established at San Antonio, Tex., has been delayed.

Although an appropriation of $14,000,000 was made by Congress for the purpose of developing the "fourth arm of the service," he explained, no provision was made in the bill for the purchase or leasing of land as sites for aviation posts. It will require a special bill of Congress for an appropriation of $1,500,000 to be expended in land.

San Antonio is to be the largest of the "flying centers" that the government proposes to establish, according to the major. Provision has been made for the organization of two air squadrons, and a third may be added.

Considerable progress has been made already insofar as 160 men with equipment, and several airplanes have been brought to San Antonio. As soon as the land is leased, hangars will be constructed and more planes supplied. Captain Thomas S. Bowen will be in command of the squadron.

United Eastern Airplane Corporation

Organization and incorporation of the United Eastern Aeroplane Corporation has just been perfected and business begun at 1251 DeKalb avenue, Brooklyn, N. Y. This concern is capitalized at one million dollars, and purposes to manufacture all the up-to-date designs of airplanes for pleasure, military and commercial purposes, on a large scale.

The incorporators include all the owners of the Eastern Aeroplane Company, Inc., with others, and the new company has taken over the old concern. Both the factory and aviation school heretofore conducted by the old company will be continued and enlarged.

In the manufacture of its machines this corporation will use quite a number of improved devices for which patents will be secured. Some of these are already in use in the military tractor biplanes manufactured by the old company and used in its aviation school at Sheepshead Bay Speedway, and the new organization will continue to specialize on this make of machine.

Site Recommended For "Langley Field"

A tract containing 1,650 acres, lying between Back River and Hampton, Va., and just north of Fort Monroe, has been recommended by a board of Army officers headed by Lieut.-Col. George O. Squier, Signal Corps, for the aviation experimental and proving ground authorized at the last session of Congress. Arrangements have been made for its purchase for $290,000, and suitable buildings and equipment will be placed thereon when additional funds become available.

The station will be known as "Langley Field," in honor of the late Prof. S. P. Langley of the Smithsonian Institution, one of the pioneers in the art of mechanical flight under government auspices. It is said to be well adapted to flights over both land and water, and amply provided with transportation facilities. It also will be valuable in time of war in connection with the defense of Fort Monroe, which guards the water approach to the National Capital, Baltimore and Annapolis.

It is proposed to equip the field with all facilities for the testing of aviation machines, appliances and accessories, and for conducting experiments of all aviation devices and apparatus. The Weather Bureau probably will establish a station on the reservation for the study and observation of air currents and atmospheric conditions for the benefit of the aviators.

Dominion of Canada Aero Club Organized

The Aero Club of Canada has been organized and sanctioned by a British Government charter. The club, which has been brought into existence largely to encourage and assist those desiring to take up aviation in order to render war service, will devote its energies also to the development of aeronautics generally.

The president of the new club is Colonel W. H. Merritt, who has long been urging the establishment of training schools for aviators in the Dominion. Lieutenant-Colonel J. B. Miller, Toronto, was elected vice-president; Adam F. Penton, Toronto, honorary secretary; Capt. D. A. Cameron, Toronto, honorary treasurer; Lieutenant-Colonel H. C. Cox, vice-president for Ontario; Carl Riordan, Montreal, vice-president for Quebec; W. R. Allen, of Winnipeg, vice-president for Manitoba; F. C. Ritchie was appointed permanent secretary, and the club will have offices in the Lumsden Building, Toronto. Three additional directors are yet to be chosen, and vice-presidents for the rest of the provinces.

U. S. S. West Virginia to Have Launching Device Fitted

The airplane mother-ship *West Virginia* is expected to arrive shortly at the Bremerton, Wash., Navy Yard to complete her overhauling for aeronautical uses. She was needed for Mexican service and was sent South before the pneumatic ram, which is the essential part of the airplane equipment, could be installed.

The ram was manufactured in Washington, D. C., after the model on the *North Carolina*, and has just been received at the yard. The ram is designed to give the car on which the airplane travels the necessary velocity to send the airship off the stern. The installation of this catapult will make the airplane equipment of the ship complete and make her the second ship so constructed in the navy.

Canadian Fliers Sent to England

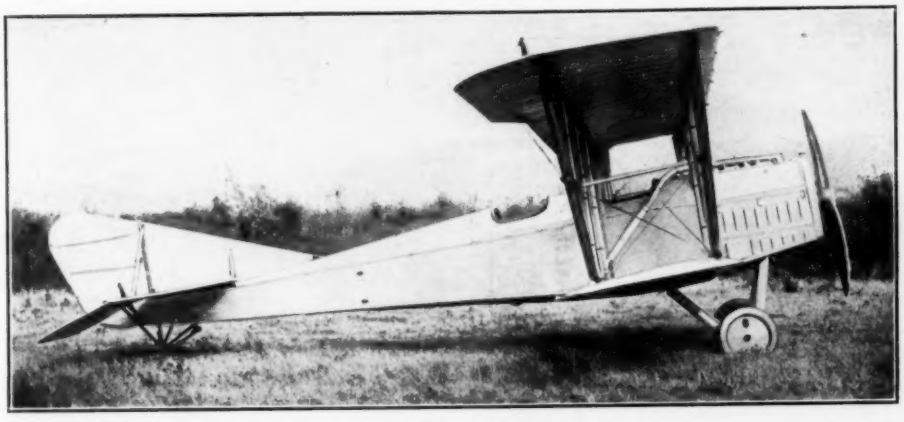
With the closing for the season of the Curtiss Aviation School at Long Branch, Ont., six students passed their final examinations. They are: K. V. Turney, W. J. Whitfield, C. G. Davis, O. F. Macgreggor, T. B. Homes and W. C. Calvert.

This makes a total of 62 students who have successfully taken their final tests since the school opened in May, as compared with 67 last year. In addition to these, the school sent 150 partially trained aviators overseas last season, making a total of 279 Canadian flyers sent to England, in addition to all the untrained men who have recently been taken on at Ottawa under the new system.

Exports of Domestic Airplanes

John Hohn of the Division of Statistics of the Bureau of Foreign and Domestic Commerce has reported that during the month of October, 1916, one airplane valued at $800 was exported.

THOMAS MILITARY TRACTORS



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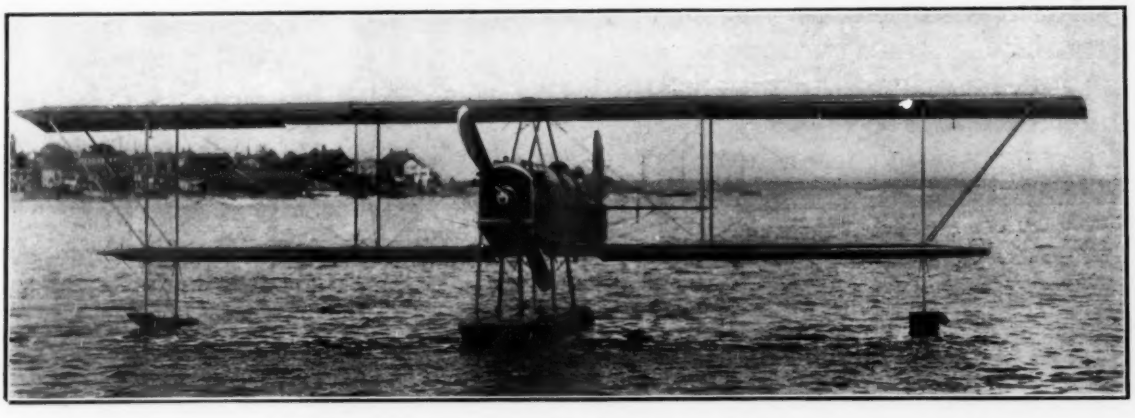

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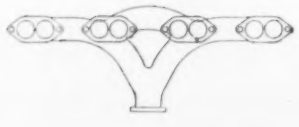

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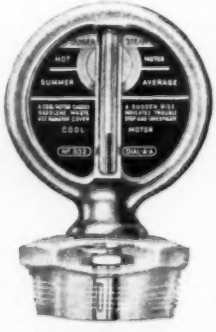

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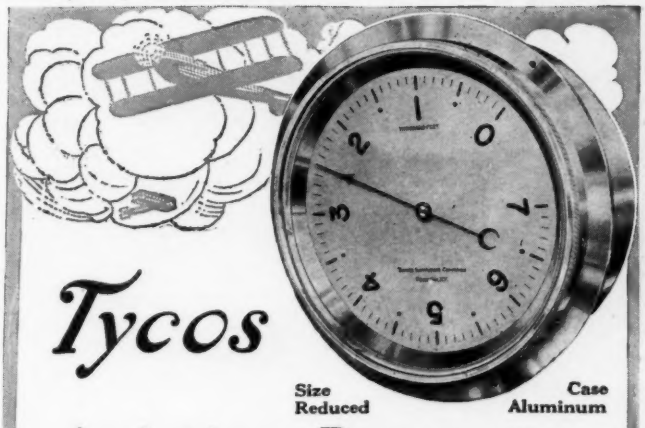

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